

# TRAFFIC FLOW ANALYSIS & EFFICIENCY OF GEOMETRIC DESIGN OF A T- INTERSECTION, A CASE STUDY

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## ABSTRACT

*The major concern for a Highway Engineer in any road network system is an intersection. The heterogeneous traffic is more diverse in nature due to lane changing and lack of lane discipline characteristics of drivers' in India. Our research is intended to check the efficiency and control of flow of traffic at "Tara Wala Pul (Bridge)-T intersection", point out flaws (if any) in the geometric design and work out the possible solutions.*

**Key words:** Intersection, Traffic Volume, Passenger Car Unit, Geometric Features, Traffic Flow Diagram.

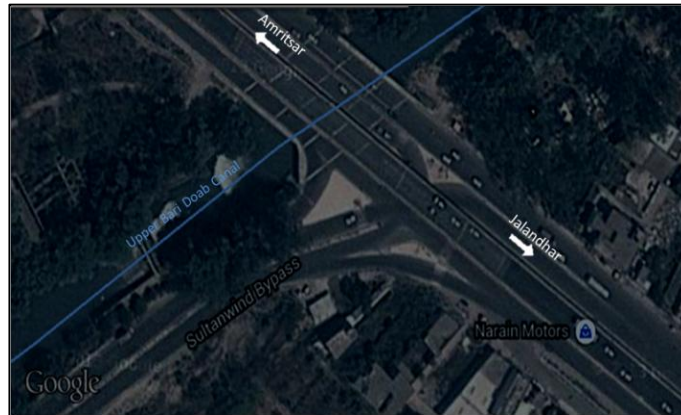
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## 1.INTRODUCTION

Tara Wala Pul (Bridge), T- intersection is located on Amritsar and Jalandhar GT-Road (Punjab). It connects NH-1(National Highway-1) and M.D.R. (Major District Road) along the Upper Bari Doab canal. NH-1 is also known as G.T. Road and M.D.R. is also known as Sultanwind Bypass Road. NH-1 is eight lane road at the intersection and M.D.R. is a four lane road. At the intersection, a flyover was recently constructed which is one way and available for traffic coming from Jalandhar and going towards Amritsar. The flyover has two lanes and the remaining lanes form the under bridge. The intersection is signalized and channelized with road islands and margins.



**Figure 1** Aerial View of Tara Wala Pul T-intersection (Source: Google maps)



**Figure 2** Elevation of the flyover at Tara Wala Pul

This intersection was a major issue for the traffic movement due to number of drawbacks. Major ones include at-grade un-signalized intersection, lesser number of lanes, less lane width, increasing no. of accidents, traffic jams etc. So it was redesigned and improved by NHAI (National Highways Authority of India). Our research is also intended is to check whether the improvement was as per IRC guidelines or not.

## 2. GEOMETRIC OBSERVATIONS

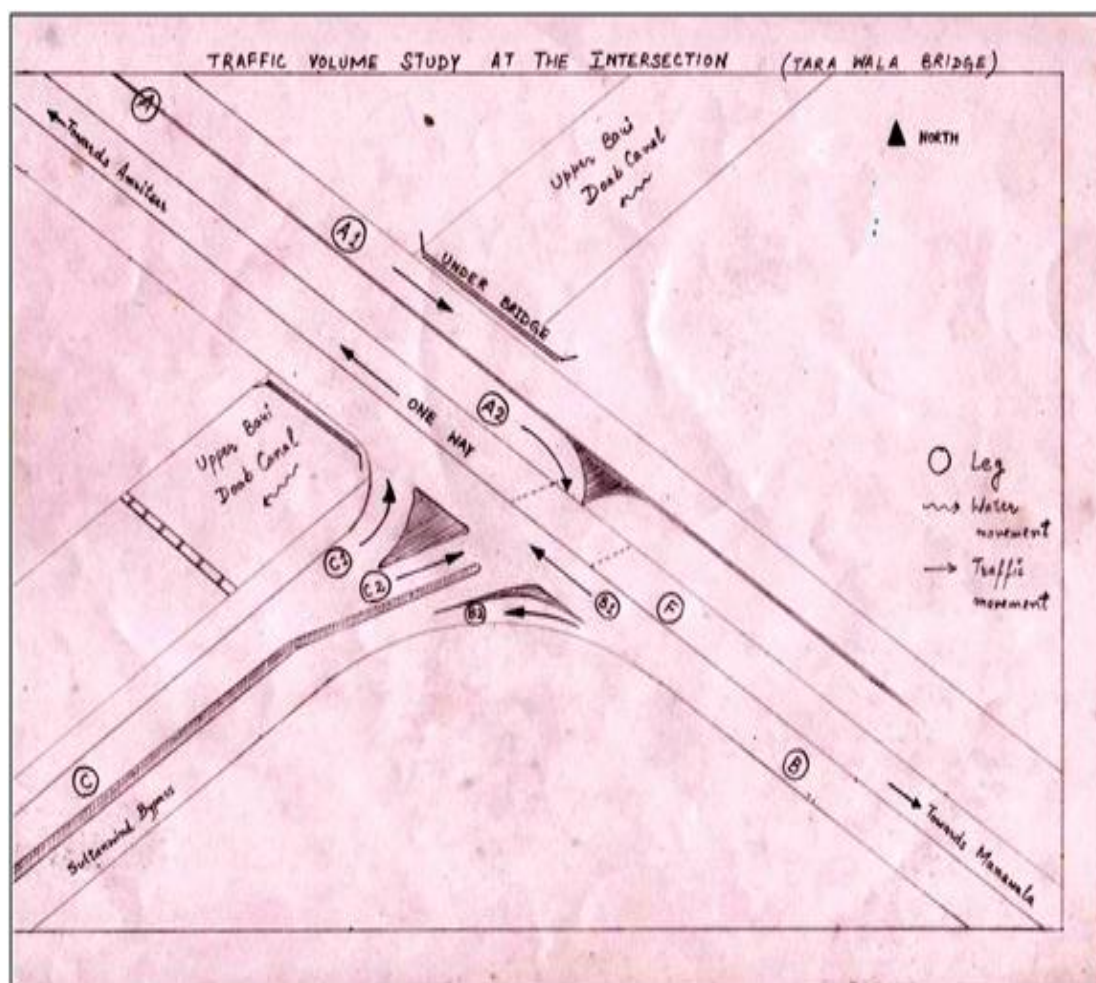
**Table1** Comparison of some observations with IRC recommendations

S No.	Characteristic feature	IRC recommendations	Observations	Inference
1.	Gradient of approaching ramp	Max. 3.5 %	1.61 %	
2.	Gradient of leaving ramp	Max. 3.5 %	1.52 %	
3.	Horizontal clearance	Min. 15 m	25 m	
4.	Vertical clearance	Min. 5 m	6 m	

**Table2** Dimensions of the Road Intersection

Length of the ramp towards Amritsar	292 m
Length of ramp towards Jalandhar	311 m
Distance between the abutments	138 m
Inclination of the Upper Bari Doab canal with the road	69° 20'

## 3. TRAFFIC VOLUME STUDIES



**Figure 3** Desorption of codes to different lanes at the Tara Wala Intersection

**Table 3** Traffic Volume counts on Leg A1 and Leg A2 (4:30p.m. to 5:30 p.m.)

Type of vehicle	No. of vehicles	PCU equivalent	PCU	No. of vehicles	No. of vehicles	PCU equivalent	PCU	PCU
				U-Turn (I)	Towards Sultanwind Bypass Road (II)		(I)	(II)
1.Motorcycles and scooters	408	0.50	204	98	196	0.50	49	98
2.Cars,tempo, auto-rickshaws, etc.	738	1.00	738	112	194	1.00	112	194
3.Agriculture tracking light commercial vehicles	05	1.50	7.50	-	-	1.50	-	-
5.Trucks and buses	102	3.00	306	-	12	3.00	-	36
6.Tractor trailer truck units	07	4.50	31.5	-	-	4.50	-	-
		Total	1287			Total	161	328

**Table 4** Traffic Volume counts on Leg B1 and Leg B2 (4:30p.m. to 5:30 p.m.)

Type of vehicle	No. of vehicles	PCU equivalent	PCU	No. of vehicles	PCU equivalent	PCU
1.Motorcycle and scooters	96	0.50	48	102	0.50	51
2.Cars,tempo, auto-rickshaws, etc.	208	1.00	208	172	1.00	172
3.Agriculture tracking light commercial vehicles	-	1.50	-	06	1.50	09
4.Trucks and buses	-	3.00	-	15	3.00	45
5. Tractor trailer truck unit	-	4.50	-	02	4.50	09
		Total	256		Total	286

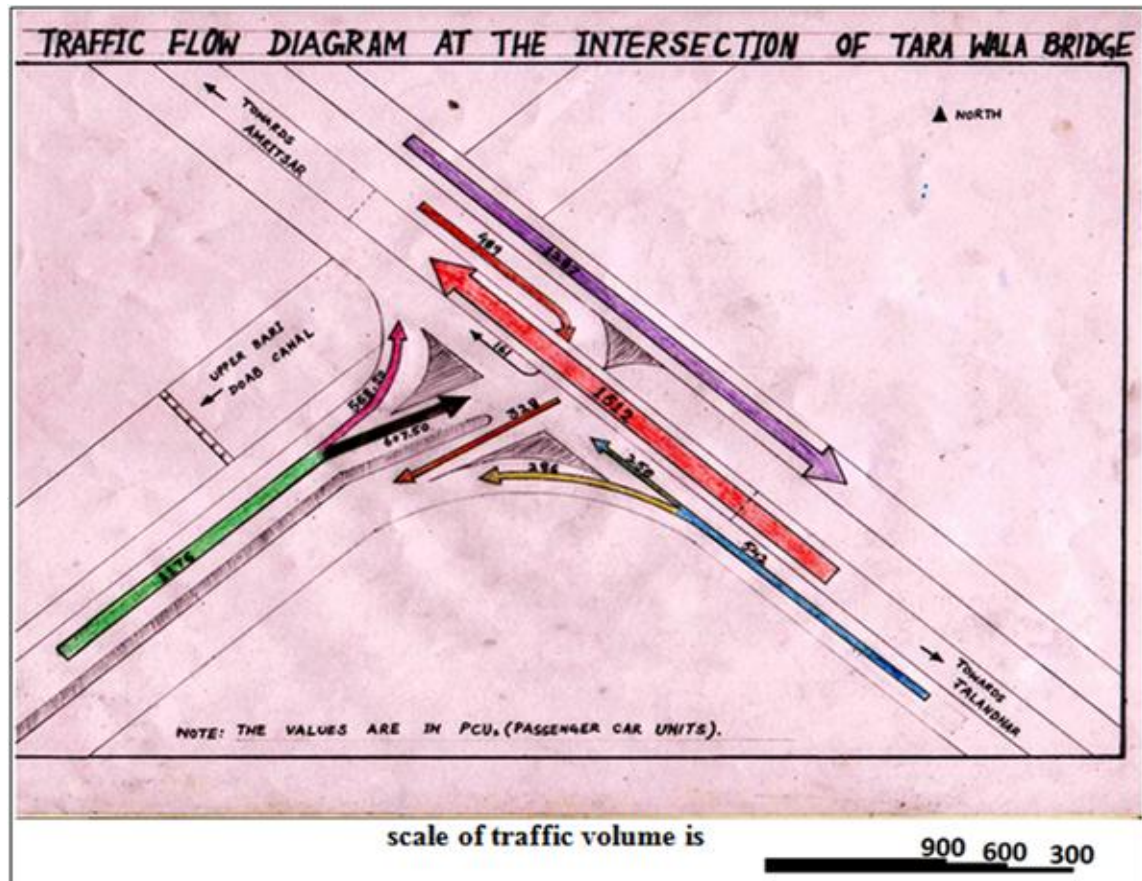
**Table 5** Traffic Volume counts on Leg C1 and Leg C2 (4:30p.m. to 5:30 p.m.)

Type of vehicle	No. of vehicles	PCU Equivalent	PCU	No. of vehicles	PCU equivalent	PCU
1.Motorcycle and scooters	108	0.50	54	156	0.50	78
2.Cars,tempo, auto-rickshaws, etc	288	1.00	288	240	1.00	240
3.Agriculture tracting light commercial vehicles	07	1.50	10.5	10	1.50	15
4.Trucks and buses	72	3.00	216	84	3.00	252
5. Tractor trailer truck units	-	4.50	-	05	4.50	22.5
		Total	568.5		Total	607.5

**Table 6** Traffic Volume counts on Leg F (4:30p.m. to 5:30 p.m.)

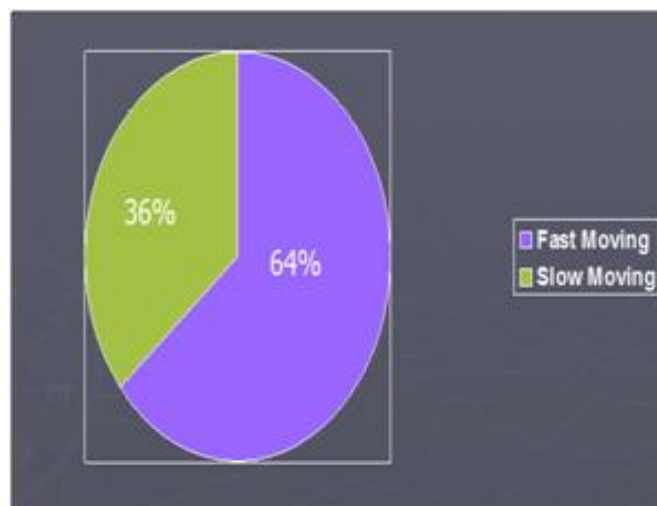
Type of vehicle	No. of vehicles	PCU Equivalent	PCU
1.Motorcycle and scooters	456	0.50	54
2.Cars,tempo, auto-rickshaws, etc.	420	1.00	288
3.Agriculture tracking light commercial vehicles	04	1.50	10.5
4.Trucks and buses	214	3.00	216
5. Tractor trailer truck units	-	4.50	-
		Total	568.5

The above observations are formulated in the form of Traffic Flow Diagram. In Traffic Flow Diagram various volumes of traffic are expressed in PCU and are represented in the form of arrows. The thickness of the arrows depicts the volume of the traffic and the direction of the arrow depicts the movement of traffic. It means that, thicker the arrow more is the volume of traffic and vice versa. The representation of the traffic volume diagram is shown below.



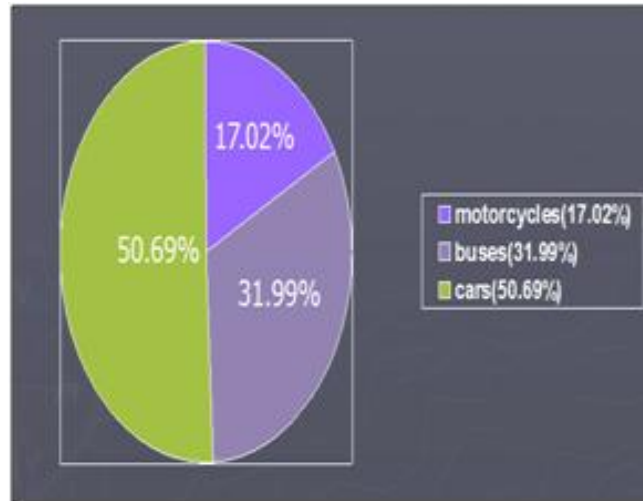
**Figure 4** Traffic Flow Diagram at the Tara Wala Bridge Intersection

The representation of the traffic volume study is also done by means of Pie charts. It gives relative percentage of different types of traffic for example: Fast moving and slow moving traffic. The data so obtained in the tabular form previously has been represented in the form of pie charts as shown in Fig5 and Fig6:



**Figure 5** Pie chart showing segregation of traffic in general





**Figure 6** Pie chart showing segregation of fast moving traffic

## 4. GEOMETRIC FEATURES

### 4.1. Road Markings

Road markings are an essential part of road geometry. At intersection it plays a vital role as the traffic is supposed to approach the conflict area. It not only helps in guiding the traffic properly but it adds to the ethnic beauty as well. So it is given equal importance as other parameters. Following are some observations as far as road markings at Tara Wala Pul (Bridge) intersection are concerned:

- The road markings at the intersection consist of zebra crossings, edge lines and dividing lines.
- The dimensions of stripes of zebra crossing are 3.5m x 0.5m.
- The edge lines are generally placed at a distance of 0.30m from the road island and at a distance of 0.50 m from the edges of the road.
- The dividing lines are dashed lines with dash length 3m and a spacing of the dash is 3 m.
- All the lines are 15cm thick.
- Reflectors are provided on the edge lines to guide the traffic during night hours.



**Figure 7** Road markings at the road intersection (Tara Wala Bridge)



**Figure 8** Road markings at the road intersection (Tara Wala Bridge)

**Table 7** Comparison of observations of road marking with IRC recommendations

S.No.	Characteristic feature	IRC Recommendations	Observations	Inference
1	Thickness of edge line, dividing line and stop lines	15cm	15cm	
2	Zebra Crossing strips Thickness Length Spacing	0.50m 3.50m 0.50m	0.50m 3.50m 0.50m	
3	Lane width	3.20 to 3.50m	3.35m	
4	Reflectors	Optional	Present	

## 4.2. Traffic Signals

Traffic signals are needed for the control of conflicting streams of vehicular and pedestrian traffic at intersections. There are three signals that direct the traffic i.e. Red (which means stop), Amber (which means clearance) and green (which means to proceed). These three signals are the lenses mounted on the signal face. The minimum number of lenses on a signal face is three i.e., Red, Amber and green. The lenses can be placed vertically or horizontally.

At Tara Wala Pul (Bridge) intersection, the traffic signals are placed as shown in the picture below. They guide the traffic that moves at the lower road and not on the flyover. Since there is a conflict area between the traffic coming from Sultanwind Bypass Road going towards Jalandhar via underpass and the traffic (usually slow moving traffic e.g. auto rickshaws) coming from Jalandhar and going towards Amritsar, traffic signals solve this problem by fixed system of signalling for each lane respectively based on the volume of traffic.





**Figure 9** Position of Traffic Signals at Tara Wala Bridge Intersection

### 4.3. Traffic Signs

Signs are intended to serve the following cause:

- To give timely warning of hazardous situations when they are not self-evident.
- To regulate traffic by conveying messages to the drivers to stop, give way or limit their speeds etc.
- To supply information on highway routes, directions and points of interest.

Road signs are classified as under:

- Mandatory signs
- Cautionary Signs
- Information Signs

The pictures shown in Fig 10 and Fig11 are some of the signs that have been used at the Tara Wala Pul (Bridge) intersection.



**Figure 10** Mandatory sign depicting 'No U-Turn' at Tara Wala Pul (Bridge) intersection



**Figure 11** Information Sign at Tara Wala Pul (Bridge) intersection

#### 4.4. Lighting

Lighting should be given utmost importance in road geometry especially at the intersection of roads. The main reason behind this is that intersection basically has a conflict area and the chances of accidents are much more. During night the risk further increases. So an intersection should have proper illumination. The parameters which should be taken into account for lighting include following:

- Height of the lights
- Type of lights (Single necked or double necked)
- Distance between the lights.
- Illumination cone covered by the lights.
- Positioning of lights.



**Figure 12** Lighting at Tara Wala Bridge intersection

**Table 8** Various parameters of lighting observed at Tara Wala Bridge intersection

S.No.	Parameter	Observation	Whether following IRC standards or not
1.	Types of lights	Single necked (on flyover) Double necked (at the lower road)	Yes Yes
2.	Distance between the lights	15m c/c (Double necked) 15m c/c (Single necked)	Yes (max. 30m) Yes (max. 30m)
3.	Positioning of lights	In the dividing island (on the road) Along both sides i.e. parapet wall (on flyover)	Yes

#### 4.5. Drainage

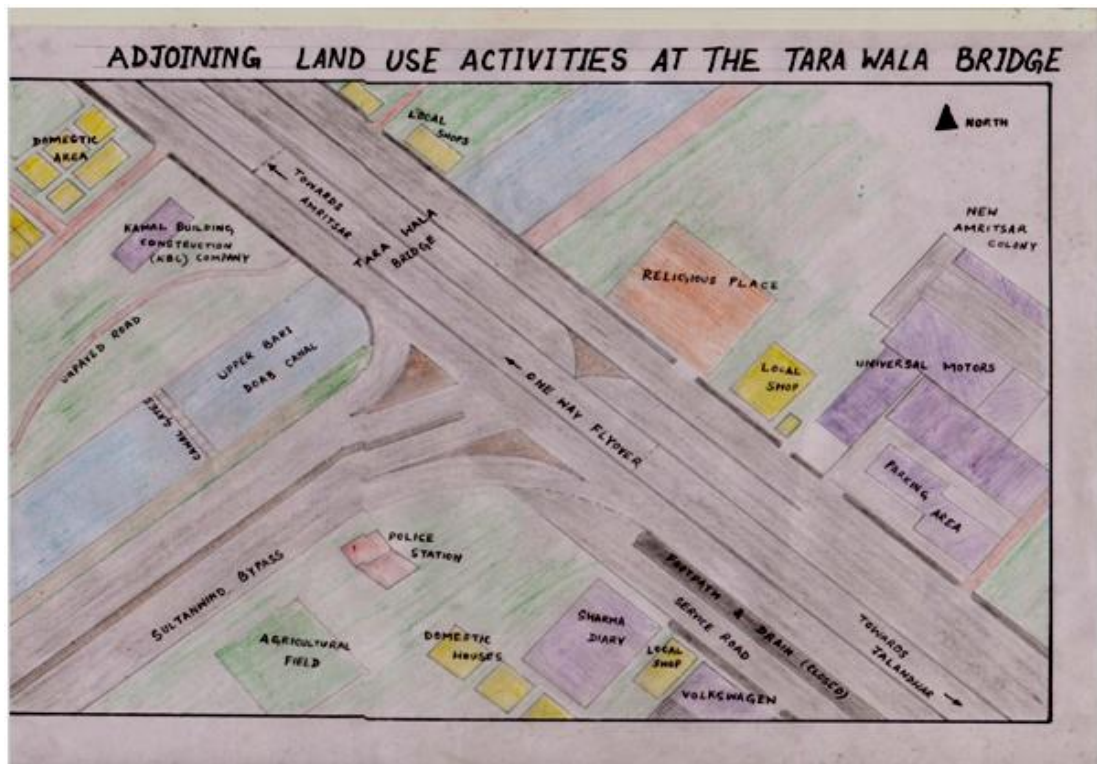
Road drainage is provided in order to avoid the stagnation of rainwater on the carriage way which could lead to the improper functioning of the traffic movement and also reduces the stability of the bituminous material of the road. Thus it should be given due consideration while designing the road intersection. Water Table should be kept

low, below and surrounding the road pavement to prevent the moisture content of the sub grade increasing, and hence decreasing the sub grade strength. If this is not done by the drains adjacent to the highway, the road pavement will weaken and fail.

**Observations:** On flyover the drainage is provided by means of cast iron pipes which drain the water into the Upper Bari Doab Canal. At the lower level the drainage is provided by means of cross slope. The drainage pipes are placed longitudinally in the dividing island. Scuppers are provided at a distance of 20m which ultimately let the water flow through the longitudinal drains.

#### 4.6. Adjoining Land Use/Activities

It is very important to survey the adjoining land of any project. This is because the features in the adjoining land may have some positive as well as negative effects on the project directly or indirectly. For example in case of densely domestic or industrial area, it becomes very difficult to go for road widening. It would increase the cost of the project heavily.



**Figure 13** Adjoining land use/activities at the Tara Wala Bridge

## 5. CONCLUSION

The analysis of Tara Wala Pul (Bridge) intersection was done by collection of various data and presenting the same in the form of tables and figures (as shown above). The collected data is compared with IRC specifications as given in different IRC codes respectively. Although almost all the geometric features and traffic flow control is as per IRC guidelines and recommendations but there were some flaws pointed out which need attention so that there would be no inconvenience to road users and also ensure safety at its best. Flaws as observed on Tara Wala Pul (intersection) have been enlisted below:

- Obstruction in sight line at curve coming from Sultanwind Road towards Amritsar. In other words, the sight distance was inadequate (i.e. 22.5m) and can cause accidents in future.
- Traffic Signals not working properly at the intersection
- Information Sign not available at the point of diversion for traffic coming from Amritsar
- Some of the street lights not working
- No central flood light present at the intersection
- No check for traffic rules violation

## 6. RECOMMENDATION FOR POSSIBLE SOLUTIONS

- Minimum sight distance should be according to the following formula:

$$SD = [0.278 Vt + V^2/254f]$$

which comes out to be = **69.82m** should be provided.

where:

- V = design speed in kmph (50kmph)
- t = reaction time (3sec)
- f = coefficient of friction (0.35)
- Proper maintenance of signals should be done.
- Information signs should be present at the respective points of divergence.
- Proper lighting should be done at the cross conflicting area.
- Traffic Police should be present at the intersection for proper enforcement of the traffic rules and regulations.

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